

## ACTIVITIES OF THE GULF COAST RESEARCH LABORATORY DURING FISCAL YEAR 1976 -77: A SUMMARY REPORT

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### ADMINISTRATION

This year was an austere one in Mississippi for all state-supported institutions of higher learning, with the Gulf Coast Research Laboratory (GCRL) receiving the same allocation (\$1,390,318) as last year for general support. This was augmented by a Special Library Improvement allocation in the amount of \$25,000 appropriated by the 1976 State Legislature and by \$210,794 generated by research grants and contracts.

As is the case with most growing institutions, the expansion of the physical plant has not kept pace with the increases in staff and activities. Therefore, the condition of "cramped quarters" has become an outstanding campus-wide problem that has caused a spillover of activities into the passageways. However, some relief appears imminent with the possible approval by the 1978 Legislature of the Laboratory's request for construction funds of the Marine Education Center Building on the Point Cadet, Biloxi, Mississippi, campus. The Board of Trustees designated this proposed building as number two in their list of priorities for next year's Capital Outlay for State Institutions of Higher Learning.

### RESEARCH VESSEL

Last year, International Marine Fabricators, Tampa, Florida, under contract with the State Building Commission, went out of business leaving unfinished the 85-foot oceanographic research vessel under construction for GCRL. Following a thorough study of the problem, the State Building Commission requested, and the 1977 Mississippi Legislature approved, the appropriation of \$525,000 with which to complete the vessel. Mr. Eric Allan of Schuller & Allan, Inc., Houston, Texas, was appointed as the marine architect to improve the vessel design, prepare bid specifications and oversee the completion of the project. The vessel is expected to be in the water and working sometime during the next year.

### BOAT OPERATIONS

Boats that provide essential services include the 65-foot GULF RESEARCHER used in both the Laboratory's research and educational programs, the 38-foot steel trawler HERMES used principally in the educational program, four diesel-powered cabin workboats, and some half-dozen Boston Whalers and other miscellaneous smallcraft powered

by outboard motors. The larger vessels are operated by six full-time boatmen, two of whom are licensed Masters for vessels of up to 100 gross tons. The Boston Whalers and other smaller miscellaneous boats are operated on a part-time basis by scientists and technicians to meet the needs of ongoing research projects.

During the year GULF RESEARCHER was at sea for 47 days and 19 nights. HERMES spent 71 days at sea and the smaller boats made innumerable trips during the same period.

### RESEARCH

Research activity increased somewhat during the year with the main thrust continuing in fisheries and environmental studies.

A contract was executed with the E. I. duPont de Nemours and Company to conduct an environmental baseline study of St. Louis Bay with field sampling to begin in the fall of 1977. The objective of the study is to generate a comprehensive data base on the ecological characteristics of the Bay estuarine system for DuPont and Mississippi. This study, funded in excess of three-quarters of a million dollars, was sought by DuPont in connection with the construction of their titanium dioxide manufacturing plant near the shoreline of the Bay. The plant is anticipated to be operational in 1979.

The Bay study will be done by 12 senior scientists and about 25 technicians from the sections of Physical Oceanography, Fisheries Research and Development, Microbiology, Anadromous Fishes, Botany, Analytical Chemistry, Environmental Chemistry, Geology, Ecology and Fisheries Management. Dr. Robert A. Woodmansee, head of the Ecology Section, is project coordinator.

A few projects for each research section are described briefly below.

#### *ANADROMOUS FISHES SECTION, Mr. T. D. McIlwain, Head*

*Development of Gulf Coast Artificial Reefs* (Funded by Mississippi-Alabama Sea Grant Program and GCRL): The states of Mississippi and Alabama have placed ten surplus Liberty Ship hulls in seven locations off their coasts. Five ships have been sunk off Mississippi in two locations. The two Mississippi reefs, monitored biweekly by personnel from Mississippi are assessed by diver survey and sportfishing methods. Divers are documenting the effects of the ships in

establishing a new reef community in the northern Gulf.

**Rearing and Stocking Striped Bass—Mississippi Gulf Coast** (Funded by National Marine Fisheries Service, U. S. Fish and Wildlife and GCRL): A new three-year striped bass project was begun in September 1976. The objectives of this program are to establish (by stocking) a striped bass population in Biloxi Bay, to stock sea-run striped bass, to determine their success, and to establish a source of fry from Mississippi brood fish.

A total of 407,583 two-inch striped bass of South Carolina origin were reared and stocked into Biloxi Bay. Of those fish, 18,808 were reared from eggs taken from Mississippi brood fish. These brood fish were taken in Pearl River near Jackson, Mississippi, by Mississippi Game and Fish Commission personnel and transported to GCRL for spawning. Out of four eligible brood fish two were tank spawned, one successfully. The successful spawn resulted in 100,000 fry. Fifty-thousand were retained for rearing at the Laboratory and the remaining 50,000 were returned to the Game and Fish Commission for rearing in ponds near Ross Barnett Reservoir.

Almost 8,010 sea-run striped bass were stocked into the St. Louis Bay system. Fourteen striped bass—fish stocked in previous years—have been returned to project personnel. These fish range in weight from one-half pound to twelve pounds.

A sampling program is in progress to check for natural reproduction of previously-stocked bass and occurrence of juvenile striped bass, and to monitor previously-stocked striped bass in order to continue assessing the results of all bass-stocking programs previously carried out in this area.

**Artificial Midwater Reef Development Program** (Funded by Mississippi Marine Resources Council): This program was carried out in conjunction with the Gulf Coast Artificial Reef Development Program. Multi-array fish attractor devices consisting of ten-foot lengths of two-inch PVC pipe were installed on the Liberty Ship hulls sunk at reef site FH-3 in the Gulf. These devices congregated schools of bait fish over the reef site and attracted large schools of desirable game fish (Spanish and King mackerel, jacks and little tunny) above the reef site. This resulted in an increase of angler creels at the reef site.

**Bait Fish Rearing** (Funded by Mississippi Marine Resources Council): A handbook is in preparation detailing the techniques for rearing bullminnows to supply the live-bait industry along the coast. Bullminnows are currently supplied to the retail market by a few fishermen using traps and/or hook and line. The bullminnow is a favorite live bait used by coastal sport fishermen. Supplies are quickly depleted in late fall when the spotted seatrout (*Cynoscion nebulosus*) are running.

*ANALYTICAL CHEMISTRY SECTION, Dr. Thomas F. Lytle, Head*

**Nutrient Study in Coastal Waters Near Areas of Offshore Oil Drilling** (Funded by the Bureau of Land Management and GCRL): As part of a National Science Foundation cruise in April 1977, water samples were collected in a time series study at a location 90°W, 28°N in Louisiana coastal waters. All nutrients and various forms are being measured to determine the diurnal cycling of nutrients and also to detect any possible effect on nutrient loads and distribution by the petroleum pollutants which were readily detected in the sediments of this area.

**Studies of Chemical Constituents of Mosses, Fungi and Lichens** (Funded by GCRL): Mosses, fungi and lichens were a dominant form of life 300 million years ago. A chemotaxonomic and geochemical study has been completed on these groups of plants. This study complements the previous study on ferns, another class of ancient plants. There were two purposes for these studies: first, to investigate the distribution of biosynthetically-related compounds, hydrocarbons and fatty acids, to a series of related ancient plants, and second, to determine what chemical changes took place in the evolution of plants. This information aids both the botanist in classification of plants and the geochemist in identifying the source material from ancient environments; i.e., oil shales, petroleum and coal fields, and also elucidates the relationship between geolipids and biolipids.

**Techniques Development for Oil Pollution Assessment** (Funded in part by the Bureau of Land Management and GCRL): This study was designed to decide upon the best procedures to analyze natural samples when trying to detect oil pollution. Included in the study were various extraction procedures, separation procedures and various types of samples both polluted and nonpolluted. The results will be published and should help others in properly designing oil-pollution monitoring studies in the marine environment. Available techniques are numerous but an effort was needed to examine the various methods to determine procedures that would yield results most easily amenable to interpretations of oil pollution.

**Sediment and Floral Hydrocarbons of the MAFLA Monitoring Program** (Funded by Bureau of Land Management, U. S. Department of Interior—Conducted jointly with the Environmental Chemistry Section): An environmental study in the northeastern Gulf of Mexico has been underway since 1974. The broad objective of the study is to provide enough information about the area that will enable the BLM to answer questions about the impact of oil and gas exploration and development on the marine environment and to establish a basis for prediction of impact on the outer continental shelf oil and gas activities in frontier areas.

The Analytical and Environmental Chemistry sections were awarded the contract to analyze the hydrocarbons in

all sediment and benthic algae samples taken from selected sample sites in the northeastern Gulf.

The offshore oil leases in the northeastern Gulf of Mexico in 1974 have resulted in an extensive program of scientific activity on the continental shelf of Mississippi-Alabama-Florida (MAFLA). The 1974 program included a baseline hydrocarbon survey of sediments of the inner continental shelf extending from Tampa, Florida, to the Mississippi River delta. Though intended as an environmental impact study, the efforts of investigators in this region have complemented previous studies concentrated in the deep basin and estuarine systems of the eastern Gulf.

Results of the initial study disclosed two distinct hydrocarbon provinces in the northeastern Gulf. The Florida shelf, rich in carbonaceous materials, was characterized by very complex mixtures of hydrocarbons which were apparently of marine origin and were dominated by a group of  $C_{25}$  branched-unsaturated compounds. Sediments of the Mississippi and west Alabama shelf, chiefly comprised of silt and clay materials, yielded hydrocarbons with a very distinct terrestrial signature of high molecular weight  $n$ -alkanes of high odd/even preference. Also in evidence was a suite of petroleum-like hydrocarbons indicating a degree of pollution on the Mississippi-Alabama shelf. The east Alabama-west Florida shelf acted as a transition zone containing pronounced contributions of terrestrial, marine and petroleum hydrocarbons.

In 1975-76 the monitoring phase of the study expanded the 1974 sample program to include deep-water sites on the outer continental shelf, sites further south on the Florida shelf and collections made during more than one season to detect short-term or seasonal changes in hydrocarbon profiles.

Perhaps the most intriguing results found in the 1975 samples involve the outer continental shelf along the northeastern Gulf. Here sediments on the Florida coast lose some of the shell hash-sand appearance of inner shelf samples and are composed of higher quantities of fine-grained materials like those found along the Mississippi coast. Hydrocarbon levels are generally higher at the deeper stations than at the shallower stations. Some contribution of marine materials is evidenced by the presence of certain hydrocarbon compounds; but, what is surprising is the obvious presence of terrestrial and petroleum hydrocarbons at these deep-water stations. It appears that sediments of composition similar to those of the Mississippi shelf are being transported as far south as the outer shelf off Ft. Myers, Florida. If that is the source, then the migration of riverine sediments and any associated pollutants may be more extensive than was previously thought. Other tagging methods including carbon isotope ratios are being checked to verify the terrestrial component of these sediments.

There are some short-term effects seen in sediment

hydrocarbon patterns of the northeastern Gulf. Only those stations exhibiting traces of petroleum-like hydrocarbons off the Mississippi-Alabama coastline reveal discernible change, that being a steady decrease in low molecular weight  $n$ -alkanes with time. Even in samples just east of the track of Hurricane Eloise (September 1975), temporal effects were of very small order.

*Sediment and Floral Hydrocarbons of the MAFLA Rig Monitoring Program* (Funded by Bureau of Land Management, U. S. Department of Interior—Conducted jointly with the Environmental Chemistry Section): In order to assess the changes in hydrocarbon concentrations and distributions in a marine sediment due to the emplacement and operation of an oil rig, sediment samples were collected from 25 strategic locations at a site on the Texas shelf before emplacement, during drilling and after drilling. These sediments were analyzed for aliphatic and aromatic hydrocarbons and 13 gas chromatographic parameters, used in assessing pollution, were calculated. A type of graphic cluster analysis was used to determine statistically changes in these 13 parameters as a function of distance from rig and collection period. We found that gas chromatographic parameters which have been developed to signal oil pollution must be treated cautiously; the natural variability can be quite large in some cases and therefore requires careful consideration of sample size for sediments used in pollution monitoring. Additional statistical techniques may be necessary in order to choose the proper sample size and replication.

This information has been needed so that BLM might be able to produce "benchmark" data which will be quantitative and for which statistical significance can be established. Statistical techniques such as cluster analysis and discriminant analysis that simultaneously assess several hydrocarbon parameters seem to show promise in the area of pollution monitoring. The hydrocarbon data have shown that at least this one part of the continental shelf of Texas appears to be the site of low-level oil pollution. The  $C_{14}$  to  $C_{20}$  region contained a series of  $n$ -alkanes with little odd/even preference and ratios of pristane/ $n$ - $C_{17}$  and phytane/ $n$ - $C_{18}$  similar to those of petroleum. The region of high molecular weight contained high concentrations of the odd carbon numbered  $n$ -alkanes with a predominance of  $n$ - $C_{29}$ . A large concentration of two components in the aliphatic fraction is tentatively identified as branched-chain olefins,  $C_{25}H_{46}$  and  $C_{25}H_{48}$ .

Even though the Texas sediments have accumulated relatively low concentrations of degraded oil, cluster analyses data show that there was little difference between samples taken before, during and after drilling even at sites only 100 m from the rig. It is concluded that exploratory oil drilling phases of offshore procedures can be achieved without radically altering the status of hydrocarbon levels and patterns of the surrounding sediments.

*BOTANY SECTION, Dr. Lionel N. Eleuterius, Head*

**Studies of Plant Colonization on Dredge Spoil** (Funded by GCRL): The study was initiated several years ago and will yield valuable information about natural colonization of spoil islands. Several spoil islands representing various ages have been monitored several times during each year to obtain information on what species colonize the spoil and what is the rate of vegetative spread. Other spoil areas are visited frequently. Botanical information is taken in reference to elevation, substrate type, soil water and soil-water salinity. Arrangements have been made with the Mississippi State Soil Testing Laboratory to analyze soil samples for levels of mineral nutrients. A cooperative effort with the Physical Oceanography Section is planned to provide tidal data.

**Salt Marsh Vegetation of Davis Bay** (Funded by GCRL): Quantitative information is being accumulated on the relationship of marsh acreage versus open water in this productive estuarine system. In addition, the total area drained and the amount of rainfall will be determined in order to study an entire estuarine ecosystem from the plant ecology viewpoint. A detailed vegetative map is being prepared as well as that of the standing crop of all marshes surrounding Davis Bay. This information is basic to further detailed botanical and ecological studies in the area around GCRL and should provide information for students, scientists and others within the State.

**Populational Studies on Salt Marsh Species** (Funded by GCRL): This on-going research is presently concentrated on the salt marsh rush, *Juncus roemerianus*. Considerable population information has been gathered on the species and a portion of it is now in manuscript form. The ultimate goal is to document the distribution and the vegetative growth pattern of the major salt marsh species inhabiting the tidal marshes in Mississippi. Such population studies are of considerable importance in relation to ecological work since ecotypes, single sexes, may dominate or compose large tracts of tidal marsh. Similar work has been initiated on *Scirpus olneyi* and *Distichlis spicata*.

**Ecological Studies on Seagrasses and Salt Marsh Species** (Funded by GCRL): Survey work will be done during July, August, and September 1977 to assess the distribution of seagrasses in Mississippi Sound. In addition, quantitative information will be developed on the ecological aspects of the shoal grass, *Halodule beaudettei*.

Ecological studies on salt marsh species will entail synecological studies where more than one species compose the vegetation. Included in this study is consideration of the hydraulic aspects of flooding of various salt marsh zones to be done in cooperation with the Physical Oceanography Section. Grand Bayou, a high-salinity marsh dominated by *Juncus roemerianus* on Deer Island, Mississippi, has been

tentatively selected for this portion of the study.

Studies of other ecological aspects of this tidal marsh have been initiated. Tidal inundation and discharge rates can be easily established because of the small, contained ecosystem represented in Grand Bayou. Quantitative data on plant productivity and the nutritive discharge of detritus and other water quality parameters will be assessed on the discharge and on the rising tide.

**Autecological Studies on Vascular Plants of Mississippi Salt Marshes** (Funded by GCRL): This project is essentially an extension of population studies, in that ecological parameters such as soil nutrients, soil-water salinity, elevation, and other chemical and physical aspects of the habitats (i.e., soil texture, evaporation) and the life history of the plant will be considered.

**Progeny and Genetic Studies on the Salt Marsh Rush, *Juncus roemerianus*** (Funded by GCRL): This work entails on-going research representing work carried out over several previous years. Plants have been grown for several years from seed to obtain Mendelian ratios, establishing the genetic mechanism responsible for the sexual distribution found in this rush species. The work constitutes an effort to obtain basic information on this species which dominates Mississippi marshes. During the past year, controlled crosses between known parental types have been achieved and their seeds are presently being germinated. Hopefully, they will produce mature plants in less than the 2 years required under field conditions.

An apparatus has been constructed in the greenhouse that will extend or shorten the day to induce flowering. Also, experiments have been conducted dealing with the physiological requirement of a cold period, known as vernalization, to induce flowering in this rush. If flowering can be induced, the growth and flowering cycle can be accelerated.

**An Illustrated Guide and Key to Salt Marsh Plants** (Funded by Mississippi-Alabama Sea Grant Program): The purpose of this work is to prepare an illustrated guide and key to the salt marsh plants of Mississippi. It will entail the preparation of line drawings and scientific descriptions and a key to the local species. At present, approximately 140 species have been collected and will be included in the key. The key is expected to be completed by the end of next year.

**A Phytosociological Study of Horn and Petit Bois Islands** (Funded by National Park Service, U. S. Department of Interior): During the first year of this two-year study, a large number of exclosures were established to assess the effect of animals such as nutria, hogs, and rabbits on the vegetation. Concurrently, phytosociological sampling was initiated to obtain information on community composition and successional patterns and interrelationships between the plant communities on these islands. Considerable effort has been made to obtain information on insular marshes which

will be part of general ecological studies on salt marshes in Mississippi. A detailed report, pointing out the special features of these insular marshes, is in preparation.

*ECOLOGY SECTION, Dr. Robert A. Woodmansee, Head*

*Baseline Environmental Survey of Plankton of the Mississippi-Alabama Continental Shelf* (Funded by GCRL): This project is designed to acquire a data base for zooplankton and related environmental parameters for the continental shelf of Mississippi and Alabama, particularly in the oil lease sale area and at the proposed site of a deep-water port. Establishment of a baseline in these areas will make it possible to assess the impact of oil exploration and production or deep-water port activities on the continental shelf.

*Daily Vertical Migration of Zooplankton in Relation to Light Intensity, Currents and Reproductive Cycles* (Funded by GCRL): The daily vertical migration of zooplankton is of significance to the probable location of plankton-feeding fish and, thus, to the probable location of fish higher in the food chain. The interaction of vertical migrations, currents and reproductive cycles provide the means by which planktonic larvae of shrimp and other forms are able to move from the offshore spawning areas into the estuaries.

*Benthic Infauna of a Residential Canal and an Adjacent Natural Area in Simmons Bayou* (Funded by GCRL): The purposes of this study are: (1) to compare the relative abundance and composition of benthic macroinvertebrates in a residential canal with those of an adjacent natural bayou; (2) to relate invertebrate abundance and composition to selected environmental parameters; and (3) to provide baseline information which may aid in determining the effects of future environmental perturbations.

*Gulf of Mexico Shrimp Management Plan* (Funded by GCRL and National Marine Fisheries Service): The goal of this study is to develop a management plan for shrimp resources of the Gulf of Mexico that will provide optimum benefits for the Gulf states and the Nation. This project is in cooperation with and under the direction of the Fisheries Research and Development Section (see).

*ENVIRONMENTAL CHEMISTRY SECTION, Dr. Julia S. Lytle, Head*

*Further Characterization of Fatty Acids and Hydrocarbons from Gulf Sediments* (Funded by GCRL and Carnegie Geophysical Institute): Many hydrocarbon components isolated from Bureau of Land Management sediment samples were only identified by a Kovats Indices. In order to fully understand where these compounds originated, it was necessary to further characterize them. Because hydrocarbon concentration levels were extremely low in the northeastern Gulf, the original extracts were not sufficient

to perform various chemical analyses. Therefore, permission was given to extract the 1974 archived sediment samples. By combining extracts from several similar sediments, we were able to collect enough for high pressure liquid chromatography separation. The olefinic fractions were separated from the saturated fractions using silver-nitrate impregnated silica gel adsorption chromatography. Various other separations allowed for cleaner gas chromatographic separations which were then identified by mass spectrometry. Information obtained from these characterizations has contributed to the understanding of the biogenesis of organic matter in marine environments.

*Sediment Size and Hydrocarbon Associations* (Funded by GCRL): To better understand transport of petroleum pollutants, it is important to know what fractions of the sediments (sands, silt, clay) the pollutants adsorb or chelate with most strongly. Several types of sediments were fractionated into sands, silts and clays, and each fraction analyzed for aliphatic and aromatic hydrocarbons. In all cases, the petroleum pollutants were associated almost entirely with the silts and clays. These fractions can get transported great distances from the original location of the spill or seep. These data correlate well with results of our BLM studies. The deepest BLM sediment samples along the Florida continental slope appeared to be polluted with low concentrations of petroleum like those from the Mississippi-Alabama coastline. At the same time, the sediments closer to the Florida shoreline were pristine. One could postulate using the results of this study, that the currents from the Gulf stream could carry the polluted clay-silt fraction from the Mississippi-Alabama coastline around the Gulf depositing it along the continental slope as far south as Ft. Myers, Florida.

*Studies of Chemical Constituents of Mosses, Fungi and Lichens* (Funded by GCRL): This project is an intersectoral operation with the Analytical Chemistry Section (see).

*Techniques Development for Oil Pollution Assessment* (Funded by GCRL): This project is an intersectoral operation with the Analytical Chemistry Section (see).

*Mississippi Oil Field Study* (Funded by GCRL): Sediment samples were collected from Grand Isle, Louisiana, along a 100-mile transect due south. This cruise was made available by the National Science Foundation on the research vessel LONGHORN from the University of Texas. Because the transect passed through active oil fields, this was an opportunity to analyze deep sediments most likely to be polluted with petroleum and to compare these samples with BLM sediment samples previously analyzed from a transect off Pascagoula, Mississippi. All sediments along the transect south of Grand Isle were highly contaminated with petroleum. The extent of pollution was on the order of ten times that of the sediments collected off of Pascagoula, Mississippi. This was not surprising since the Louisiana

coastline has long been an area of active oil drilling. This study documents hydrocarbon analyses in sediments along the Mississippi trough in the Gulf of Mexico.

**Sediment and Floral Hydrocarbons of the MAFLA Rig Monitoring Program** (Funded by Bureau of Land Management, U. S. Department of the Interior): This project is an intersectional operation with the Analytical Chemistry Section (see).

**FISHERIES MANAGEMENT SECTION, Mr. William J. Demoran, Head**

**Oyster Atlas** (Funded by GCRL): An updated survey of natural, public oyster reefs was undertaken during the period. An Atlas of the public reefs was furnished the Mississippi Marine Conservation Commission to be used in granting private oyster leases. The Commission is presently in the process of leasing water bottoms where public oyster reefs do not exist. The Atlas comprises three maps showing natural, public reefs.

**Oyster Bottom Survey** (Funded by GCRL): Potential oyster leases were examined in western Mississippi Sound to determine if any natural, public oyster reefs were included in the leases. Also, the bottom where leases were requested was examined for suitability. Under a new law, which gives the Mississippi Marine Conservation Commission additional power and authority for leasing water bottoms in the State, these two requirements must be fulfilled before a lease is granted.

**Development of a Regional Fishery Management Plan for Gulf Menhaden** (Funded by National Marine Fisheries Service): The section head, in collaboration with the Fisheries Research and Development Section, served as a member of the Menhaden Task Force which developed a regional management plan for the menhaden fishery of the Gulf of Mexico.

**Environmental, Legal and Management Aspects of a Proposed Oyster Depuration Facility** (Funded by Mississippi-Alabama Sea Grant Program): The success of any depuration operation depends on interagency cooperation among the many agencies concerned with the shellfishing industry. The section is in the process of contacting controlling agencies in states with existing depuration plants or which have operated plants in the past, to determine their management procedures. These will be compiled and utilized to develop a management plan for submission to state and federal agencies which must approve or cooperate in such an operation. Considerable input into this plan is expected from both state and federal levels. It is expected that the resulting management plan will detail the procedures governing harvesting of oysters from polluted waters and transportation of same to the depuration plant. The plan will also detail procedures for in-plant operation that will insure that

oysters released from the plant for sale are safe for human consumption.

**FISHERIES RESEARCH AND DEVELOPMENT SECTION, Mr. J. Y. Christmas, Head**

**Fishery Resources Monitoring and Assessment** (Funded by National Marine Fisheries Service and GCRL): Three years of sampling in the original monitoring and assessment project were completed in September 1976. All stations were sampled every month. Analyses of the resultant massive data bank provided detailed information about relative abundance, life history, condition, survival and growth of important exploited species in Mississippi waters. Computer programs were refined for compiling and analyzing data.

A new three-year project was approved, effective 1 January 1977, to continue this program. Cooperative efforts to provide data leading to achievement of optimum yield from fishery resources are continuing. Appropriate segments of this work have been closely coordinated with NMFS's research in Gulf waters. Continuing liaison with the Mississippi Marine Conservation Commission (MMCC), Mississippi-Alabama Sea Grant Consortium, numerous other state and federal agencies and industry representatives have provided for a progressively improved scientific base for fishery management.

The Mississippi brown shrimp crop for 1977 was outstanding. The MMCC opened the Mississippi shrimp season in accordance with recommendations based on monitoring and assessment data collected for them. Catch data are not complete but preliminary estimates indicate a near-record volume and record value as indicated in monitoring and assessment data. White shrimp followed typical patterns of abundance with a good crop predicted for the fall harvest in 1977. Pink shrimp show increasing numbers from year to year with wider distribution observed during periods of unusually high salinity.

Blue crabs, after a period of relatively low population levels during part of the study period, showed a strong year class developing in the spring and early summer of 1977 and more crabs were available than processors could handle.

Finfish populations in general remained healthy with some annual fluctuations in response to changing environmental factors. Young-of-the-year croaker showed annual increases through the 1975-76 year class but smaller numbers appeared in the 1976-77 year class. Survival to recruitment in the offshore population seems to be lower than expected. Young-of-the-year speckled trout increased dramatically in the last two years. Good fishing from these year classes is expected to start next year.

**Fisheries Planning** (Funded by GCRL): Active participation in fishery planning activities of National Marine Fisheries Service, Gulf States Marine Fisheries Commission, the

Commission's Technical Coordinating Committee and sub-committees, Gulf State-Federal Fishery Management Board, Sea Grant Association, Mississippi Marine Resources Council, Mississippi Marine Conservation Commission, Gulf of Mexico Fisheries Management Council and several professional societies provided for effective input of Mississippi's position in practically all Gulf of Mexico fishery planning activities. Project personnel served as a member of the Mississippi Marine Conservation Commission.

Management plans for Gulf of Mexico menhaden and shrimp were completed after approval and adoption by the Gulf State-Federal Fisheries Management Board. The Gulf of Mexico Fisheries Management Council expressed an interest in coordination of Council plans for fishery management in the offshore Fisheries Conservation Zone with plans for regional management in State waters.

*Statistics on Subsistence Fishing in Coastal Counties of Mississippi* (Funded by National Marine Fisheries Service and GCRL): The manuscript comprising the completion report for this project reports new information acquired in the three-year study.

Mississippi Marine Conservation Commission requires licensing of all boats and vessels utilizing gear generally used by commercial fishermen. There are no provisions for licensing or regulating recreational fishing. Many licensees sell a small part or none of their catch. Additionally, commercial fishermen utilize a part of their catch for home use. That part of the catch of licensed fishermen which is not sold was designated as the subsistence catch. The subsistence catch is not reported in commercial fishery landings.

Catch and effort data for the subsistence fishery were collected from random samples of licensed commercial fishermen in open season during the 1974 to 1976 study period. Subsistence fishermen reported using shrimp, crabs and four species of finfish. The subsistence catch was equivalent to over 12 percent of reported landings of these species caught in Mississippi waters, to 3.7 percent of Mississippi landings of these species and had an annual dockside value of \$180,000. Cost of expendables was estimated at \$141,029 per year. Areal and seasonal distribution of catch and effort were discussed.

*Development of a Regional Fishery Management Plan for Gulf Menhaden* (Funded by National Marine Fisheries Service): "The Menhaden Fishery of the Gulf of Mexico United States: A Regional Management Plan" was published (May 1977) as Technical Report Series, No. 1, Gulf Coast Research Laboratory. The 53-page document was developed in a series of five open-meeting workshops utilizing "management by objectives" techniques. The Gulf Menhaden Management Task Force was established when the Gulf State-Federal Fisheries Management Board approved a project proposal for development of a Gulf Menhaden Management Plan. Representatives of each of the five Gulf states fishery

management agencies, the National Marine Fisheries Service, each of the five menhaden companies operating in the Gulf of Mexico and specialists from several universities contributed invaluable time to attending workshops and completing "homework" assignments.

The Plan document includes a summary, a description of the resource and fishery, present management system and associated problems, goal and objectives, proposed system, recommendations and a management action program summary in seven chapters. A discussion of planning methodology and chronology and a list of references cited (101) are appended.

The Task Force recognized 20 problems in the fishery and made 24 recommendations leading to solution of these problems. The dynamic nature of the plan was stressed and provision was made for regular reassessment and updating as necessary. This project was carried out as a cooperative effort between Gulf Coast Research Laboratory and the University of Southern Mississippi.

*GEOLOGY SECTION, Dr. Ervin G. Otvos, Head*

*Offshore Barrier Island Study* (Funded by GCRL): This was a study of the geologic history, genetic conditions and present-day state of six Mississippi-Alabama barrier islands. Seven coreholes were drilled on Ship Island and five on Horn Island in 1976, and drilling (three coreholes) on Petit Bois Island continued during June 1977. Sediment and micropaleontological analyses have been completed for samples obtained in 1976 on Horn and Ship Islands. Assistance in sea and land transportation was provided by the U. S. National Park Service. The Civil Air Patrol provided assistance with aerial photography of the islands.

*Marsh Bottom Soil Sample Analysis Project* (Funded by GCRL): The first stage of this work was completed in conjunction with the Botany Section. About 50 samples were analyzed to determine their granulometric composition. The correlation of soil properties thus obtained, with marsh vegetation characteristics, is expected to yield meaningful results.

*Foraminifer Studies in Lake Pontchartrain and Adjacent Coastal Water Bodies, including Biloxi Bay-Biloxi Back Bay: Geological Evolution of Lake Pontchartrain* (Funded by GCRL): The foraminifer composition of Lake Pontchartrain bottom deposits is quite unusual, as the oligohalin lake, with salinities commonly between 3 and 6 ppt, contains patches of calcareous-rich areas. Presettlement Pontchartrain deposits were also found with high-calcareous foraminifer-influxes. These contrast strongly with the Biloxi Bay fauna with usually higher salinities. Interpretation of the results sheds light on the Holocene recent geological history of the area. The results of this study will be reported in the *Journal of Foraminifer Research*.

**Holocene Geology of Hancock County Marshland** (Funded by GCRL): The largest marshland on the Mississippi coast also contains large sand ridges and extensive prehistoric shell mounds. Earlier drilling results, field surveys and botanical surveys are being integrated into a report, presently in preparation, that will give an account of the Holocene evolution of the premarsh area, the marsh itself and various peculiarities of its present vegetation. The unusual plant assemblages covering Indian middens will be emphasized. This study is being done in conjunction with the Botany Section.

**Mississippi Coast Stratigraphy and General Geology** (Funded by GCRL): Studies of earlier-obtained cores continued in the sedimentation laboratory. This is part of an on-going study of the Pleistocene-Holocene evolution of the entire coast. Several field trips and collections supplemented the core studies, especially in the Hancock County area where the Biloxi and Prairie Formations have been investigated.

**Pleistocene Geological Evolution of Southeastern Louisiana** (Funded by GCRL): Areas adjoining the Mississippi Gulf Coastal Plain contain significant proof of the time the surficial sediments of the plain complex evolved. The problem of a mid-Wisconsin interstate, a period of relatively warmer climate and higher sea level stand might be more closely approached by the study of river terrace sediments in the St. Francisville area and near Slidell, both in Louisiana. The terrace stratigraphy of this area has an immediate impact on the various stages of the Pleistocene evolution of the coast. Field work and radiocarbon age determinations have proceeded.

**Chenier Genesis and Nomenclature in the U. S. A. and Worldwide** (Funded by GCRL): Cheniers are rare and peculiar coastal ridge systems, found also in the north-central Gulf coastal plain. An effort is being made to clarify problems in the literature relating to nomenclature and to classify these features. Work done in the Hancock County marsh area, especially drilling results, will be incorporated in this project. This study is being done with the collaboration of W. A. Price, Corpus Christi, Texas.

**The Bartram Trail, National Heritage Land Trust Program** (Funded by GCRL): The Mississippi Bureau of Outdoor Recreation requested the Geology Section to supply data and recommend locations for the Mississippi sections of a national system of William Bartram Trails (a bicentennial national project). The locations to be developed are in the area of the five coastal counties. The sites would be of unusual geological, geographical and general interest.

MICROBIOLOGY SECTION, Dr. David W. Cook, Head

**A Study of the Genus *Bacillus* in Marine and Estuarine Sediments** (Funded by GCRL): The distribution, taxonomy

and ecology of the genus *Bacillus* in the estuarine environment is being investigated. Under intense study this year has been a newly isolated and previously undescribed strain of *Bacillus cereus* which produces orange pigmented asporogenous mutants. Pigmentation in the mutants is affected by the metal ions present in the seawater component of the culture medium.

**Bacteriology of the Blue Crab Industry in Mississippi** (Funded by GCRL): Both research and service are the thrust of this project. Research is being conducted into the bacteriology of blue crab meat spoilage with the emphasis on determining if spoilage is brought on by a specific kind of bacteria. The service phase of this project is dealt with under Special and Community Services.

**Persistence and Degradation of Insecticides in Estuarine Water and Sediment** (Funded by GCRL): This project is one of a continuing nature and involves the persistence and/or degradation of organophosphorus and chlorinated hydrocarbon insecticides in the estuarine environment. Both chemical and biological (especially microbiological) degradation are of concern, as are the various by-products resultant from the breakdown of these materials. Insecticides studied to date include malathion, parathion, methyl parathion, diazinon, and mirex. Two bacteria capable of metabolizing methyl parathion have been isolated into pure culture, but neither microbial or chemical degradation of mirex has been demonstrated.

**Insecticide Persistence in Natural Seawater as Affected by Salinity, Temperature, and Sterility** (Funded by U. S. Environmental Protection Agency): The objective of this research effort was to determine the effect of temperature, salinity, and sterility on the persistence of malathion, parathion, methyl parathion, diazinon, and methoxychlor in natural seawater. Three temperatures (10°, 20° and 30°C) and four salinities (1, 10, 20 and 28 ppt) were employed in these investigations. Sterile and nonsterile treatments were included for each temperature and salinity.

This project was concluded and the final report is currently in preparation, but the data indicate that the disappearance of malathion, parathion, methyl parathion, and diazinon increased with increasing temperature, increased with increasing salinity, and was not affected by sterility. No degradation of methoxychlor was observed under any of the test conditions employed herein. Two bacteria capable of degrading methyl parathion and two capable of degrading diazinon were isolated into pure culture.

**Acute Toxicity of 3-Chloro-4-Methyl Benzomine Hydrochloride to Shrimp and Crabs** (Funded by U. S. Department of the Interior, Fish and Wildlife Service): A total of 150 penaeid shrimp and 225 blue crabs were exposed to 3-chloro-4-methyl benzamine hydrochloride (starlicide) for 96 hours under standard, static, bioassay conditions. Starlicide concentrations for shrimp were 50, 25, 10, 1.0, 0.1, and



zero ppm ( $\mu\text{g/g}$ ) and 50, 25, 20, 15, 10, 1.0, 0.1, and zero ppm for crabs. Symptoms of death were lack of gill movement and particularly no response to touching with a glass rod. Regression analysis was employed to analyze the data, producing a calculable TLM (or  $\text{LD}_{50}$ ) of 10,789 ppm for shrimp and 15,991 ppm for crabs.

**The Determination of the Acute Toxicity of Dredged Material to Fish and Macroinvertebrates under Standard, Static, Bioassay Conditions** (Funded by GCRL): Surface sediment (0–4 inches) was collected both from the inner harbor and the approach channel at the Broadwater Beach Marina in Biloxi, Mississippi. These sediment samples were then processed in accordance with U. S. Environmental Protection Agency guidelines and utilized as toxicants to blue crabs and mysid shrimp under standard, static, 96-hour, bioassay conditions. No deaths were observed with the blue crab, while shrimp deaths were at random and not associated with sediment concentration. Similar studies involving penaeid shrimp and sheepshead minnows are currently in progress.

**St. Louis Bay – Effluent Toxicity Evaluations** (Funded by E. I. duPont de Nemours & Company): The toxicity of a simulated industrial waste discharge to penaeid shrimp, blue crabs, oysters, sheepshead minnows, and mosquitofish has been determined under standard, static, 96-hour bioassay conditions. The effluent utilized in these investigations was prepared in accordance with the maximum daily averages listed on page 2 of 14 of permit No. MS 0027294, Mississippi Air and Water Pollution Control Commission. Effluent concentrations employed were 50, 35, 20, 10, 1, and zero percent.

No mortalities were observed in crabs, oysters, sheepshead minnows, or mosquitofish, during the 96-hour test period. A calculable  $\text{LD}_{50}$  value of 36.36 percent was obtained for shrimp, a level that is clearly unrealistic in the natural environment. Additional investigations with penaeid shrimp are currently in progress.

**Evaluation of Methods for Long Term Freezer Storage of Blue Crab for Use in Picking Plants** (Funded by Mississippi Marine Resources Council): Live crabs are being processed by two methods prior to freezing and storage to determine if either method is suitable for long term storage of frozen crabs for later use. When the crabs are removed from storage they are further processed and picked. Crabmeat from both processes is being compared with unfrozen crabs for organoleptic acceptability, pickability, bacteriology and storage life.

**MICROSCOPY SECTION, Dr. Harold D. Howse, Head**

**Morphological Study of the Brown Shrimp Gill** (Funded by GCRL): This study utilized the transmission electron microscope to examine the structure of the brown shrimp gill and to characterize the various cell types. As outgrowths

of the body wall, each gill (19 pairs total) is covered by a cuticle which is periodically shed during molt. The epithelium underlying the cuticle is adapted not only for efficient respiration, but also for cuticle secretion and osmoregulation. The gill is innervated, is vascularized with blood sinusoids and vessels, and has an extensive internal defense system of free and fixed phagocytes. The results of this study provide a basis for future applied research to assess the effects of pathological agents and environmental stresses upon the gill.

**Effects of Cadmium on Teleost Gills** (Funded by GCRL and the University of South Alabama School of Medicine, Mobile): This study was initiated, in collaboration with the University of South Alabama School of Medicine, to study the gills of spot (*Leiostomus xanthurus*) that were exposed to various concentrations of cadmium and to determine morphological changes that might result from exposure to this heavy metal.

**Ultrastructure of Lymphocystis in the Heart of the Silver Perch, Bairdiella chrysura (Lacépède), including Observations on Normal Heart Structure** (Funded by GCRL): This study was completed and revealed that the fine structure of normal heart muscle from the silver perch, *Bairdiella chrysura* (Lacépède), is similar to that previously reported for marine and freshwater teleosts.

Cardiac lymphocystis is a viral disease manifested by single, giant-cell lesions variously located in the epicardium, trabecular spaces, and subendocardium—in direct apposition to myocardial cells. Occasionally, the hyaline capsule of lymphocystis cells partially surrounds myocardial cells but causes no pathological changes or inflammatory reaction.

The lymphocystis cells contain typical cellular organelles, including the viroplasmic net unique for these cells. Annulate lamellae, often continuous with the rough endoplasmic reticulum, are present, usually along the periphery of the cell. Some elements of the rough endoplasmic reticulum are dilated and contain a finely granular material, but others contain cross-banded fibrils, each having a periodicity of 30 nm. Similar fibrils are present in the perinuclear cisternae.

**OYSTER BIOLOGY SECTION, Dr. Edwin W. Cuke, Jr., Head**

**Oyster Spat Monitoring Program** (Funded by GCRL): This project is concerned with the time and intensity of setting of oyster "spat" in various areas of Mississippi Sound and on two barrier islands. It also includes elucidation of major fouling organisms such as barnacles and their seasonality.

**Plankton Samples** (Funded by GCRL): A program to monitor the number of bivalve larvae in bay water was initiated in May 1976 at the Oyster Hatchery, Point Cadet, Biloxi, to serve as an index of spawning activity in local

oysters. Results of samples generally correlate with the spat set observed on asbestos fouling plates. It is hoped that this will become a useful tool for the Mississippi oyster industry in predicting the best time for planting cultch material to maximize spat set. This method has been used in other oyster growing areas and has proven to be generally reliable.

**Oyster Growth and Mortality Study** (Funded by GCRL): Several locations in Mississippi Sound and adjacent waters were chosen for this study to compare the rate of growth and mortality of various oyster "seed" types, including hatchery-reared stock. Preliminary data indicate that oysters placed in a lagoon on an offshore island have significantly higher growth rates than those at other locations. Concurrent histological studies provide data on gonadal maturation of oysters at the different stations.

**Biological and Ecological Studies of the Oyster Boring Clam** (Funded by GCRL): The life cycle of this clam has been documented; its burrowing mechanisms have been examined. Data on distribution and population dynamics of boring clams in Mississippi Sound have been expanded. Research continues on the reproductive biology including the gonadal cycle and natural setting periods. Morphological studies on the adult clams are also in progress.

**Gametogenesis and Spawning of the Mississippi Sound Oysters** (Funded by GCRL): Monthly and bimonthly gonad samples from oysters collected in the western portion of the Mississippi Sound have been preserved and examined to determine the effects of temperature and salinity on annual spawning cycles. This two-year study will be completed by December 1977.

**Black Drum Predation on Oysters and Other Invertebrates** (Funded by GCRL): This study has produced the first documentation of the predatory behavior and predation rates for this little known species. Results suggest that large black drum may be the most destructive oyster predators in the Mississippi Sound.

**Colonization and Growth of Benthic Invertebrates on Artificial Reef Structures (Liberty Ships) in the Northern Gulf of Mexico** (Funded by GCRL): This multi-pronged study has documented the invertebrate faunal succession on new artificial reef structures. Organisms studied include hydroids, polychaetes, and amphipods.

**Oyster Depuration in Mississippi: Environmental, Legal and Management Assessments** (Funded by Mississippi-Alabama Sea Grant Program): This one-year study is the first of a three-year project that will prepare the state and oyster industry for eventual onshore depuration requirements of the U. S. Food and Drug Administration.

**Free-Living Marine Invertebrates of Mississippi Sound and Adjacent Waters: A Summer Monitoring Program** (Funded by GCRL): This student-oriented monitoring program seeks to further our knowledge of the major invertebrate assemblages present in Mississippi Sound and adjacent waters.

**PARASITOLOGY SECTION, Dr. Robin M. Overstreet, Head**

**Parasites of Commercially Important Fishes** (Funded by National Marine Fisheries Service and GCRL): This project primarily concerns the use of parasites to indicate migratory and feeding behavior of the Atlantic croaker. Feeding habits of several other local finfishes are also being investigated by analyzing stomach contents. The project additionally covers aspects of the effects of selected parasites on their respective hosts.

**Parasites of Marine Animals in the Northern Gulf of Mexico** (Funded by Mississippi-Alabama Sea Grant Program and GCRL): This project is divided into studies dealing with parasites infecting finfishes and shellfishes of commercial interest and those capable of infecting or causing disease in man. The latter studies predominantly include those concerned with parasites that can infect or cause disease in man if infected hosts are eaten raw or inadequately prepared.

**Handbook of Marine Parasites of the Northern Gulf of Mexico** (Funded by Mississippi-Alabama Sea Grant Program and GCRL): This project was established January 1977 to provide an illustrated handbook for the layman to help him understand some common parasites he is likely to encounter in finfishes and shellfishes.

**Gulf Coast Survey of Fish and Shellfish for Parasites Pathogenic to the Human Consumer** (Funded by Food and Drug Administration, U. S. Department of Health, Education, and Welfare): The purpose of the project is to survey four finfish and four shellfish seasonally from Mississippi, Texas (Galveston), and Florida (Tampa) for ascaridoids, heterophyids, and other parasites of public health importance. Representatives of those parasites found are fed to mice and to other mammals to determine their ability to live in or cause pathological changes in the hosts.

**A Study of the Diseases of Fish of Mariculture Potential: Parasites and Parasite-Borne Diseases of Red Sea Mulletts (Mugilidae)** (Funded by the United States-Israel Binational Science Foundation): Because Mediterranean mulletts have been maintained successfully in ponds and because disease in those fish is a serious problem, the diseases of Red Sea mulletts were studied so as to judge the potential of those fish in culture. Emphasis also centered around heterophyid infections, since these trematodes can be transmitted to man.

**Studies on Helminths of the Northern Gulf of Mexico Region** (Funded by GCRL): A determination of parasites of hosts involved in the above projects as well as other hosts is included in this study. This includes life histories of the parasites and the relationships between parasites and hosts.

**PHYSICAL OCEANOGRAPHY SECTION, Mr. Charles K. Eleuterius, Head**

**Hydrography of Mississippi Sound** (Funded by Mississippi-Alabama Sea Grant Program): This was the last year of a

multi-year investigation of the hydrography of Mississippi Sound in which flow patterns, water structure characteristics and temporal and spatial distribution of nutrients were studied. The information obtained on the circulation and character of these estuarine waters is essential to the intelligent planning for Mississippi's coastal development, marine resources, maritime commerce and other marine-dependent industries. Because of the scope and intensity of work, results of the study are being published in a series of reports and technical papers.

**Wave Refraction Analysis** (Funded by Mississippi-Alabama Sea Grant Program): Loss of life and erosion of valuable waterfront property have been attributable to an adverse wave climate in Mississippi Sound and on the seaward side of the barrier islands. Applying a computer wave-refraction model, utilizing linear-wave theory, to a uniform bathymetric grid of the study area generates refraction diagrams. These diagrams, when interpreted, will show the locations of high energy areas and wave caustics under varying wave climates. The information will be useful in marine navigation, especially to the inexperienced boat operator, and to land owners and engineers in employing methods to prevent further erosion of waterfront property.

**Characterization of Tidal Bayou and Development of Statistical Evaluation/Monitoring Techniques** (Funded by GCRL): This is a continuing study of a critical area of estuarine systems, the contributory—especially the tidal bayou. Data to ascertain the most useful parametric statistics to characterize the system have been collected for the past three years. In addition to establishing baseline statistics, statistical techniques are being developed for monitoring the bayous for changes that might ordinarily go unnoticed.

**Hydrography of Petit Bois Pass Area of Mississippi Sound** (Funded by Mississippi-Alabama Sea Grant Program and GCRL): The water characteristics, flow patterns, temporal and spatial distribution of nutrients, water temperature and salinity of this segment of Mississippi Sound were studied. Information on the area, one of the two large nursery areas in Mississippi and Alabama remaining in near-pristine condition, was practically nonexistent prior to this investigation. The information gained through this research effort provides not only baseline data but also an insight into the dynamics present. Used by the proper agencies, this knowledge could help prevent unwise alterations to the area which makes a substantial contribution to the Mississippi and Alabama fisheries.

**Air-Sea Heat Flux** (Funded by GCRL): Water temperature is an important factor in the growth and migration of marine species. Attempting to forecast an opening date for shrimp-ing season based on a statistical shrimp size is hampered by the variability in growth rate which is dependent, in part, on the temperature of the water. This study includes the development of a predictive, stochastic model of heat flux in

Mississippi Sound which will provide a means of predicting the thermal structure of the water column when given a set of initial conditions.

*PHYSIOLOGY SECTION, Dr. A. Venkataramiah, Head*

**Studies on the Time Course of Salinity and Temperature Acclimation in the Commercial Brown Shrimp *Penaeus aztecus* Ives** (Funded by U. S. Army Corps of Engineers): The interim report of this project (1973–1976) was submitted to the U. S. Army Corps of Engineers in August 1976 and was approved in December 1976. The revised final report submitted in February 1977 is presently in press at the U. S. Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi.

Some of the important findings of this study were: (a) juvenile brown shrimp (95 mm mean length) transferred directly from a control salinity of 15 ‰ were apparently acclimated to a 10 to 25 ‰ range within a day and to a 2 to 36 ‰ range within a week at 25°C; (b) the ranges of salinity acclimation that occurred within one and seven days decreased to 10 to 25 ‰ and 5 to 25 ‰, respectively, when temperatures were changed to 18°C or 32°C; (c) between the two extreme temperatures, adjustment to salinity changes was more favorable in cooler (18°C) rather than in warmer (32°C) temperatures; (d) in contrast to the widely accepted conclusions, discrepancies were found between the respiratory and blood osmoregulatory patterns in the time course of acclimation process as a result of temperature change from 25°C. On this basis, the implications were discussed of accepting oxygen consumption as an exclusive criterion for the state of acclimation. Salinity and temperature optima were shown to vary in relation to the size (age) of brown shrimp, and physiological and behavioral responses were not significantly affected due to minor changes in the ionic ratios of Na<sup>+</sup>, K<sup>+</sup>, Ca<sup>++</sup> and Mg<sup>++</sup> of the holding medium. However, major ionic changes have produced physical abnormalities and high mortality, particularly in 18°C and 32°C conditions.

**Evaluation of the Nutritive Value of Grass from High Marsh Areas for Brown Shrimp *Penaeus aztecus* Ives** (Funded by Mississippi Marine Resources Council): Experimental work and data analyses of this project were completed and the final report was submitted in August 1977. The studies were undertaken to determine the feasibility of utilizing the marsh grass *Spartina patens*, and shrimp waste from the canning industry as a source of nutrition in shrimp culture. The rough consistency of the grass, low protein content (4 percent) and lack of acceptance by shrimp as food seem to rule out such a possibility. The juvenile shrimp have shown a tendency to utilize the decomposed grass as a protective covering rather than as food. The shrimp have exhibited a relatively better preference toward the grass pellets bound

with fish concentrate as an attractant, although growth and survival with the pellets are not significantly higher. However, the supplementation of shrimp waste evidently improves the survival and growth.

**Studies on the Molting Frequency of Postlarval Brown Shrimp *Penaeus aztecus* Ives in Relation to Salinity** (Funded by GCRL): The tentative conclusions from this study are that test salinities 5, 10, 15, 25 and 35 ‰ have shown no significant effect on the molting frequency of postlarval shrimp. Size, however, has some effect on the molting frequency. Postlarvae in the initial length range of 9–12 mm and weighing less than 40 mg per animal molted every three or four days. Those in the initial length range of 10–15 mm and heavier than 60 mg per animal molted at an average of five days within a three-to-seven-day range. Larger postlarvae of 18–22 mm molted every five or six days.

**Development of Penaeid Shrimp Larviculture for Use as Laboratory Animals** (Funded by GCRL): The ready availability of shrimp postlarvae in the late 1960s and early 70s from several agencies along the Gulf of Mexico and southern Atlantic coast did not create any need for developing our own larviculture techniques. As a matter of fact, this facility saved us considerable manpower, laboratory space and other problems.

The postlarval supply has decreased in recent years either because of a shift in the research interests of the above laboratories from penaeid shrimp, or due to a reduction in the larviculture operations for budgetary reasons. This forced dependency on nature for postlarvae is strictly a seasonal affair. The development of larviculture at this laboratory will not only eliminate dependency on nature but will also provide laboratory-raised animals of known history on a year-round basis.

**Determination of Calcium Levels in Blood, Muscles and Exoskeleton of Brown Shrimp Raised on Calcium-Deficient Diets** (Funded by GCRL): While evaluating the nutritive value of marsh grass it was found that exoskeletons in a large number of shrimp raised on pure grass were either extremely soft or were of less-than-normal hardness, possibly due to lack of adequate calcification. The absence of soft exoskeletons in shrimp which received the control diet indicates that food is possibly their major source of calcium ions. These findings seem to be important in formulating shrimp diets used under controlled conditions. In view of this, further experiments will be conducted to monitor the calcium levels in blood, muscles and exoskeleton of shrimp provided with diets consisting of different levels of calcium salt.

**Effect of Starvation on Blood Osmoregulation and Oxygen Consumption of *Penaeus aztecus* Ives** (Funded by GCRL): "Standard Metabolic Rates" are measured ideally under the simplest and least physiologically demanding conditions by starving the test animals. Starvation is known to

influence the oxygen consumption rates significantly in crabs and to deplete the energy reserves in blood, muscles and liver in fishes. However, the effect of starvation is little understood on the osmoregulation in brown shrimp, particularly in view of the fact that food is a possible major source of calcium. As such it is necessary to know how starvation of the test animals would affect the osmoregulation. Also it is important to know whether there is any significant correlation between the osmoregulatory and respiratory responses under starvation.

**Effect of Temperature Changes on the Lethal Dissolved Oxygen Levels in *Penaeus aztecus* Ives** (Funded by GCRL): Hypoxia is one of the major causes of heavy mortality in mariculture ponds. In comparison to fishes, very little is known about the lethal dissolved oxygen (LDO) levels in the crustaceans of commercial importance. The LDO levels of brown shrimp have been determined earlier at this laboratory in relation to size and salinity changes. Evidently temperature is an even more important factor in shallow-water habitats because of its influence on the saturation of oxygen and on the respiratory rates of estuarine animals. Our preliminary studies on temperature effect have shown that: (a) with a decrease in temperature from 32°C to 18°C, brown shrimp survived at decreased LDO levels, (b) female shrimp died at relatively higher LDO levels than males, and (c) the survival time in hypoxia increased significantly with decreasing water temperatures.

**Biochemical Analyses of the Stomach Contents of Brown Shrimp during their Estuarine and Oceanic Life Phases** (Funded by GCRL): Reports from our laboratory and from others have indicated that brown shrimp cease to grow to adulthood under laboratory conditions beyond the subadult stage of 125 mm mean length. Indeed, growth did not occur beyond this length even after 18 months of holding. In nature the shrimp become adults, mature and spawn in offshore waters. Some workers attempted to bring the shrimp to maturity under laboratory conditions by simulating some of the oceanic conditions in relation to pressure, salinity, pH and different wavelengths of light. However, none of these studies have yielded the desired results. In light of this background, analysis of the biochemical composition is planned of the food contents of juvenile and adult shrimp during estuarine and oceanic phases, respectively. On the basis of this information, attempts will be made to formulate food pellets by approximating the above compositions and for testing in the raising of shrimp.

SYSTEMATIC ZOOLOGY SECTION, Mr. C. E. Dawson, Head

**Systematic Studies on Various Groups within the Families Gobiidae, Microdesmidae, Dactyloscopidae and Syngnathidae** (Funded by National Science Foundation and GCRL): Work

was conducted on an undescribed species of the goby genus *Quisquilius* from the Ascension Island collection. Exhaustive studies on the pipefish genus *Hippichthys* and *Ichthyocampus* were completed and work was initiated on the genus *Penetopteryx* (and relatives), *Oostethus* and *Bhanotia*. Large amounts of data were accumulated in connection with the review of western Atlantic sand stargazers (Dactyloscopidae). Work continued leading to the review of western Atlantic pipefishes and on the distribution of tropical American shore fishes. In pursuance of these problems, studies were conducted on fishes at the following museums: Museum National d'Histoire Naturelle, Paris; Rijksmuseum van Natuurlijke Historie, Leiden; British Museum (Natural History), London; American Museum of Natural History; Peabody Museum; Museum of Comparative Zoology; Field Museum of Natural History; Rosensteil School of Marine Sciences; U. S. National Museum.

### SPECIAL FACILITIES

#### *MARINE EDUCATION CENTER, Mr. Gerald C. Corcoran, Curator*

Visitations to the Marine Education Center increased from 19,675 in FY 76 to 23,844 in FY 77. Distribution of an informative leaflet to the local hotels and motels along the beach and also distributed by the Sea Grant Advisory service is credited with part of this increase, as well as tourists to the area.

The marine science courses for teachers that are taught at the Center had an enrollment of sixty-nine students—fifty-six in the basic course and thirteen in the advanced course.

With the cooperation of biology teachers from Gulfport and Biloxi High Schools, an outstanding student from each school is selected to further their studies at the Marine Education Center concerning local marine life. Informal instruction, along with practical experience, is given these students for approximately three months. At the end of that time two new students are selected to participate in this marine life enrichment program. It is hoped that all coastal high schools will participate and, in the near future, schools throughout the state will be able to enter students during summer vacation.

The Center prepared three slide sets concerning local flora and fauna; three sets of slides to aid in the identification of local poisonous and nonpoisonous species to present to the local school systems. Film strips available with recorded tape cassettes on the above subjects will be available in the near future.

Educational leaflets have been prepared on the horseshoe crab and the speckled trout and are now being distributed at the Center.

#### *OYSTER HATCHERY*

The Oyster Biology Section continued research and development activities at the Oyster Hatchery in 1976. These activities included, but were not limited to the following: algal culture experiments (for larval and adult oyster food), experimental conditioning of mature oysters for out-of-season spawning, determination of the effects of vertebrate and invertebrate predators on seed oysters, design and testing of greenhouse and raceway culture systems for adult and seed oysters, and operational testing and maintenance of various hatchery systems. Hatchery-reared seed oysters have been provided to researchers in Mississippi and adjacent states for cooperative field and laboratory testing and mariculture attempts.

The enactment of Mississippi's Oyster Leasing and Relaying Law of 1977 has eased the requirement for hatchery-reared seed oysters, but not the requirement for additional knowledge and understanding of oyster spawning and settling cycles in Mississippi Sound. Hatchery personnel monitor larval oyster populations in plankton on a regular basis to assist those who wish to plant cultch material for natural spat-collecting purposes. Hatchery research on the effects of predators on attached and unattached (cultch-free) seed oysters will provide information on which cultch materials are best suited for maximum production of natural seed on leased oyster grounds.

The Oyster Hatchery has become one of the primary educational facilities of its type in the Gulf of Mexico region. Students and private individuals from many states and foreign countries have visited the hatchery and/or enrolled in the aquaculture course taught there during the Summer Academic Program. Those students enrolled for the past three years have received on-the-job training in oyster culture techniques and have conducted research on various aspects of aquaculture using the hatchery's facilities and systems. Many of those students are now pursuing graduate degrees and/or aquaculture-related vocations as a direct result of their training and experiences at the hatchery. Hatchery-reared seed oysters are presently being utilized by one Ph.D. candidate to assess the potential of intensive oyster culture in various parts of Mississippi Sound and adjacent waters. Results to date indicate that protected bayous on Mississippi's offshore islands offer the best potential areas for intensive oyster culture.

The hatchery's potential as an educational and research facility has been demonstrated and its contributions to marine science and to the Mississippi oyster industry should continue to increase and expand in the years ahead.

#### *THE GUNTER LIBRARY, Mr. Malcolm S. Ware, Senior Librarian*

The Gunter Library received about 2,000 publications in the form of reprints and separates from more than 250

research centers around the world through exchange. Book purchases amounted to 260 volumes; three new titles were added to the regular standing orders (250 titles), and back runs of journals were purchased with Special Library Improvement Funds to augment 32 journal titles.

A number of donations were received throughout the year; the most significant single donation was a master file of publications donated by the Mississippi-Alabama Sea Grant Consortium, which also pledged continuing monthly donations of reprints. Drs. John E. and Eleanor J. Tobie of the National Institutes of Health, and Dr. J. W. Ward of the University of Mississippi Medical Center donated lengthy runs of journals. Mr. Charles Lyles of the Gulf States Marine Fisheries Commission and Dr. Peter A. Isaacson of the State of New York Department of Public Service contributed publications in quantity. Mr. and Mrs. Wade Guice of the Harrison County Civil Defense Office and the Library of the University of Mississippi Medical Center were among the donors. The Gunter Reprint Special Collection continued to grow through the kindness of Dr. Gordon Gunter, Director Emeritus, GCRL.

The Dauphin Island Sea Laboratory Library and The Gunter Library exchanged duplicate journals which added qualitatively to both collections. Interlibrary loans sent out numbered around 100 items and loans received exceeded 375. The ratio of items borrowed to items loaned is statistically 4 to 1 because the figures necessarily include photocopy requests and do not reflect the fact that The Gunter Library actually served a larger number of libraries throughout the state than any previous year.

In July 1976, Miss Mary Lou Thornton of McComb, Mississippi, a senior in Library Science at the University of Southern Mississippi, completed her internship with the Library.

From August 1976 through January 1977, the Library cooperated in a continuing loan program to provide Geo-Marine, Inc. of Richardson, Texas, with literature for the completion of a Biloxi River study.

In October 1976, The Gunter Library joined the majority of medical libraries on the Mississippi coast in forming the Gulf Coast Biomedical Library Consortium. The Consortium is dedicated to sharing resources, services, and programs to improve overall library service and meet its members' needs for biomedical information. The Gunter Library has been selected to act as a clearinghouse for inquiries and information concerning the Consortium.

*ICHTHYOLOGY RESEARCH MUSEUM, Mr. C. E. Dawson, Head*

The Museum, part of the Systematic Zoology Section, collected specimens in Panama and Venezuela during February 1977. The Panama work was conducted in cooperation with the Smithsonian Institution.

Eight hundred ten lots of fishes, representing about 6,000 specimens were cataloged. Total vertebrate holdings now include 15,704 cataloged lots; approximately 146,000 specimens. The collections also contain 1,074 cataloged lots of invertebrates.

An important collection of fishes from Ascension Island was received from The Division of Marine Invertebrates, U. S. National Museum. Gifts of specimens were also received from the University of South Alabama; Louisiana Department of Wildlife and Fisheries; Rosenstil School of Marine Sciences; Rijksmuseum van Natuurlijke Historie; Museum of Zoology, Lisbon; Australian Museum; Western Australian Museum and H. I. H. The Crown Prince of Japan.

Loans of specimens were made to a number of U. S. and foreign institutions. Materials for identification were received from a number of U. S. sources as well as from Panama, Venezuela, Brazil, Colombia, Australia, France and Mexico.

*WATER ANALYSIS LABORATORY, Dr. Thomas F. Lytle, Head*

Operated by the Analytical Chemistry Section, the Water Analysis Laboratory has processed samples for the Physical Oceanography, Physiology, Microbiology, Ecology, Botany and Fisheries Sections. Sample types have been water, media, marsh plants and sediments. The analyses conducted have included: nitrate, nitrite, ammonia, Kjeldahl nitrogen, orthophosphate, total phosphorus, salinity, dissolved oxygen, sulfate, suspended solids, chlorophyll, phaeophytin, sodium, magnesium, iron, potassium, calcium, zinc and copper. These have resulted in 3,432 sample analyses. The Water Analysis Lab has also served in an advisory capacity to various staff members in planning sampling programs and has on numerous occasions helped people in the private sector with information on analytical problems.

*COMPUTER SECTION, Mr. David Boyes, Head*

Work began on several data retrieval systems, multi-dimensional statistical analysis programs, and higher forms of graphical routines. The training program for section personnel has resulted in an increase of machine time required for data processed and a reduction in time required to bring a program from planning to production stage.

Final equipment and programs were acquired for the tie-in of the Laboratory's IBM-1130 computer system with the Xerox Sigma IX system at the University of Southern Mississippi, Hattiesburg. The tie-in should be completed by early fall of 1977.

*PUBLIC INFORMATION/PUBLICATIONS SECTION, Miss Catherine Campbell, Head*

News releases on a variety of newsworthy subjects were provided to 50 selected daily and weekly newspapers,

television and radio stations, wire services and special correspondents.

Briefings on the research and academic programs and guided tours of the facilities were given to an average of one junior and senior high school science class per week during the regular school year. Briefings and guided tours are provided by the Section to summer students and by the Administrative Officer to college field trip students throughout the school year.

Duplicate sets of colored slides were made for a descriptive program on the Laboratory, and programs on two types of seafood processing. These programs were furnished to the public on request. A printed narration sheet and also a taped narration on cassette are available.

The Section provided participation by GCRL in three exhibits or public events during the year. An exhibit booth was set up during the Harrison County Community Fair on the Coast, sponsored by the MSU Extension Service. It featured the Laboratory and seafood industry slide programs and a display of GCRL and other publications on marine life. The Marine Education Center personnel set up two aquaria in the booth, one with a live horseshoe crab from salt water and a freshwater amphipod. *Marine Educational Leaflets, Marine Briefs*, brochures on the MEC and GCRL and sheets telling how to prepare and serve shark dishes were handed out to the public. The Section set up a Laboratory literature display including scientific journals and curriculum information during the Academy of Sciences annual meeting in March. For the Mississippi Arts Festival in Jackson, the Section added to the display of marine specimens and staff publications located in the Mississippi Museum of Natural Science. At the request of the museum, a special program of 140 colored slides of marine life and a 45-minute narration on cassette were also furnished to be used by the Museum staff during the Festival.

The Laboratory's public information program "On Course," continued to be broadcast weekly by six coastal radio stations, WLOX and WVMJ of Biloxi, WPMP and WKYK of Pascagoula, WOSM of Ocean Springs, and WPUP of Bay St. Louis. In addition, WSLI of Jackson and WJDQ and WDAL of Meridian began carrying the program.

Volume 5, Number 2 of the Laboratory journal, *Gulf Research Reports*, was published in December 1976. This number contained five papers and two short communications; it introduced an annual report on GCRL activities for fiscal year 1975-76, written by the Director. Seven hundred twenty-five copies of the journal were mailed.

*Marine Briefs*, the GCRL monthly newsletter continued to be published for the sixth year and mail distribution ranged from 3300 to 3500 copies.

Three new Marine Educational Leaflets were printed. Leaflet No. 7, "Seagrasses and Marine Algae of Mississippi Sound;" Leaflet No. 8, "The Biology (Life Cycle) of Penaeid

Shrimp in Mississippi Sound," and Leaflet No. 9, "The Off-shore Barrier Islands of Mississippi and Alabama." Leaflets are distributed primarily through the MEC, the PIO/Publications Section, the new Gulf Marine State Park in Biloxi, and the Gulf Islands National Seashore.

A new publication, entitled the Technical Report Series, was introduced in the spring. The first issue, published in May, was entitled "The Menhaden Fishery of the Gulf of Mexico/United States: A Regional Fishery Management Plan." By the end of June, the Section had begun working on the second issue of the Technical Report Series, this one entitled "The Shrimp Fishery of the Gulf of Mexico/United States: A Regional Fishery Management Plan."

### ACADEMIC PROGRAM

*SUMMER SESSION, Dr. David W. Cook, Registrar*

The 1976 summer academic session was the largest in the history of the Laboratory with 126 students registering individually for a total of 170 student courses. Fifty-two students registered through Mississippi schools; 59 through out-of-state affiliates and 15 through nonaffiliated out-of-state institutions. Formal courses offered during the 1976 session were:

Marine Chemistry, Drs. Julia S. Lytle and Thomas F. Lytle, staff

Salt Marsh Ecology, Dr. Lionel N. Eleuterius, staff  
Physical Marine Geology, Dr. Ervin G. Otvos, staff  
Chemical Marine Geology, Drs. Ervin G. Otvos, Julia S. Lytle and Thomas F. Lytle, staff

Marine Microbiology, Drs. David W. Cook and William W. Walker, staff

Introduction to Marine Zoology, Dr. Buena S. Ballard, Southwestern Oklahoma State University

Marine Vertebrate Zoology and Ichthyology, Dr. J. William Cliburn, University of Southern Mississippi  
Marine Invertebrate Zoology, Dr. Edwin W. Calk, Jr., staff

Marine Fisheries Management, Mr. J. Y. Christmas, staff, and visiting specialists

Aquaculture, Dr. Edwin W. Calk, Jr., staff  
Parasites of Marine Animals, Dr. Robin M. Overstreet, staff

Marine Ecology, Drs. Robert A. Woodmansee and James T. McBee, staff

Marine Botany, Dr. R. B. Channell, Vanderbilt University

Introduction to Behavior and Neurobiology of Marine Animals, Dr. Leo S. Demski, Louisiana State University Medical School

Special Problems in Marine Science, staff

During the 1976-77 academic year, 69 students earned credit in courses in marine science for teachers that were

offered through the Marine Education Center located in Biloxi. Courses offered were:

- Basic Techniques in Marine Science for Teachers, Mr. Gerald C. Corcoran, staff
- Advanced Studies in Marine Science for Teachers, Mr. Gerald C. Corcoran, staff

#### GRADUATE RESEARCH PROGRAM

Courses offered in the graduate research program during this period in which students have participated included: Seminar, Special Problems in Marine Science and Graduate Research in Marine Science.

Three new students were accepted into the Graduate Research Program, one student already in the program withdrew and two completed their research projects and returned to their parent campuses. Eight students in the program were candidates for the master's degree and seven candidates for the doctorate.

Each candidate's name, thesis title, degree sought and home university are listed below according to the research sections directing their work:

**Botany Section:** Stephen H. Sky-Peck, "The inorganic nitrogenous nutrient requirements of *Juncus roemerianus* and *Spartina alterniflora* in the Gulf of Mexico," M.S., University of Mississippi.

**Ecology Section:** Jerry A. McLelland, "The summer vertical distribution of Chaetognatha in the northeastern Gulf of Mexico," M.S., University of Southern Mississippi.

John P. Steen, Jr., "Factors influencing the spacial and temporal distribution of selected crustacean plankton species in Davis Bayou," Ph.D., University of Mississippi.

**Oyster Biology Section:** David H. Barnes, "Seasonal succession and community changes of the polychaete population on an artificial reef," M.S., University of Southern Mississippi.

David A. Blei, "A successional study of the hydrozoans inhabiting an artificial reef in the north central Gulf of Mexico," M.S., University of Southern Mississippi.

Neil Cave, "Predator-prey relationships involving the American oyster *Crassostrea virginica* Gmelin, and the black drum *Pogonias cromis* Linnaeus, in the Mississippi Sound," M.S., Southern Louisiana University.

Alfred P. Chestnut, "Substrate competition between *Crassostrea virginica* Gmelin and associated sessile marine invertebrates," Ph.D., University of Southern Mississippi.

John D. DeMond, "Amphipod fouling of an artificial reef in the north central Gulf of Mexico," M.S., University of Southern Mississippi.

Katherine A. McGraw, "A comparison of the growth and survival rates of hatchery-reared and natural oyster spat at selected locations in Mississippi Sound and adjacent waters," Ph.D., University of Washington.

**Parasitology Section:** Daniel R. Brooks, "Systematic studies on the digenetic trematodes of crocodylians with emphasis on the family Acanthostomidae," Ph.D., University of Mississippi.

Thomas L. Deardorff, "Nematodes of the genus *Thynnascaris* Dollfus, 1933, (Aniskaidae) in the northern Gulf of Mexico," Ph.D., University of Mississippi.

Alan C. Fusco, "The life cycle and development of *Sirocamallanus* sp.," M.S., University of Southern Mississippi.

Tom E. Mattis, "Larval development of two trypanorhynch cestodes from Mississippi Sound," Ph.D., University of Southern Mississippi.

Mobashir Ahmad Solangi, "Pathological changes in some estuarine fishes when challenged by crude oil fractions," Ph.D., University of Southern Mississippi.

**Physiology Section:** Zubir bin Din, "The food and feeding habits of the common bay anchovy, *Anchoa mitchilli* diaphara Hildebrand," M.S., University of Mississippi.

#### SPECIAL AND COMMUNITY SERVICES

##### FISHERY ASSISTANCE

Technical assistance has been provided in response to numerous requests from local fishery industries and to the Mississippi Marine Conservation Commission. Up-to-date information has been maintained on fishery and processing problems, regulations and pending legislation.

Assistance was provided the newly formed Mississippi Shellfish Packers, Inc., a processors' organization, with regard to their presentation to the Mississippi Marine Conservation Commission in opposition to an ordinance banning the taking of crabs with eggs. This led to mutually acceptable modifications in the ordinance.

A conference in blue crab technology was organized with the cooperation of the Sea Grant Advisory Service and held at the Laboratory. A crab meat picking machine was demonstrated at the conference. Subsequently, two Mississippi crab meat processors purchased and installed machines in their plants.

Fishery assistance personnel conducted pre-season shrimp sampling for the MMCC. These data were used by the Commission to help determine the opening date of the shrimp season.

Various and sundry information and advisory assistance were provided on a number of industry problems throughout the year.

##### SEAFOOD SANITATION

The Microbiology Section has provided bacteriological product testing to local crab processors. These services, conducted at the request of plant owners, are in addition to the



routine samples taken by the Shellfish Sanitation Division of the Mississippi State Board of Health. GCRL services entail a bacteriological survey of the crab from the cook until final packing of the meat. This technical surveillance enables the crab processor to keep a close check on the product he produces, thus ensuring the customer a high-quality product. The same type of assistance is provided to local oyster packers.

In the five months that this bacteriological assistance was offered, GCRL personnel collected and tested over 280 samples (400 manhours) and traveled approximately 375 miles. Each sample was checked for total aerobic counts at 35°C and 20°C, total coliform and total fecal coliform as outlined according to FDA standards.

An educational program entitled "In-Plant Sanitation—Crab Packing Plants" was developed to assist the local crab industry in the education and training of plant personnel. The program is designed to train new personnel in methods of proper sanitation and provide a refresher course for established workers. The slide program is presented by a trained microbiologist. Samples of participants' hair, nails, and smears of hands are cultured on bacteriological media and shown in a follow-up program. It is anticipated that the program will be implemented in all crab-packing plants and be presented at least twice a year. There are plans to make a program on sanitation available in the near future to other area seafood processing plants.

#### ENVIRONMENTAL AFFAIRS COMMITTEE

This Committee is composed of all senior GCRL scientific staff members and is coordinated by the Ecology Section. It provides an interdisciplinary consideration of environmental problems in the wetlands and estuaries of Mississippi, primarily as a service to the Mississippi Marine Resources Council, which partially funds this work. However, the Committee also cooperates with other State and Federal agencies on special projects not under direct jurisdiction of the MMRC. The majority of these tasks entail reviewing permit requests for work proposed in the wetlands and estuaries. Committee members are asked for comments and recommendations on each permit request. In most cases, a site visit is made by representatives of the Committee. Based upon these inputs, a letter is drafted to the MMRC stating any objections the Committee may have, reasons for these objections and recommendations which may reduce or eliminate the objections.

The Committee reviewed approximately 55 permit applications throughout the year. In addition, an environmental evaluation of an industrial discharge in Mississippi Sound was conducted, and benthic samples were taken and processed for U. S. Fish and Wildlife Service personnel evaluating potential spoil areas for modification of the

Pascagoula Ship Channel. Several members of this Committee were involved in meetings with the Mississippi Air and Water Pollution Control Commission in conjunction with the Jackson County 201 Plan.

#### PUBLIC SEMINARS

The Gulf Coast Research Laboratory hosts a series of staff seminars throughout the year. These seminars are open to the public and speakers include invited scientists as well as officials from various levels of local, state and federal government. The central purpose of the seminars is to promote better dissemination, understanding, and use of scientific information at all levels of society. Seminars presented during fiscal year 1977 were as follows:

*"Organization and Continuity of Cell Organelles"* by Miss Carolyn Foster, Microscopy Section, Gulf Coast Research Laboratory, July 13, 1976.

*"Behavioral Effects of Electrical Stimulation of the Fish Brain"* by Dr. Leo S. Demski, Department of Anatomy, LSU Medical School, July 27, 1976.

*"The Biology of the Galapagos"* by Dr. Martha Nez, Department of Biology, Pensacola Junior College, August 17, 1976.

*"Developments in Scientific Data Analysis"* by Mr. David Boyes, Computer Section, Gulf Coast Research Laboratory, August 31, 1976.

*"Turbidity Plume Studies—Offshore Mobile Bay"* by Dr. George Crozier, Assistant Director, Dauphin Island Sea Laboratory, September 14, 1976.

*"The Role of the Dauphin Island FDA Laboratory in the National Shellfish Sanitation Program"* by Mr. Maynard W. Presnell, Gulf Coast Technical Service Unit, U. S. Food and Drug Administration, October 26, 1976.

*"Present Trends in Shrimp Mariculture"* by Dr. A. Venkataramiah, Physiology Section, Gulf Coast Research Laboratory, November 16, 1976.

*"The Sonoran Desert and Adjacent Life Zones"* by Dr. Terry Marsh, Associate Professor of Biology, North Central College, Naperville, Illinois, December 19, 1976.

*"Mississippi Sound Circulation"* by Mr. Charles K. Eleuterius, Head, Oceanography Section, Gulf Coast Research Laboratory, December 14, 1976.

*"Preserving Mississippi's Natural Heritage"* by Mr. Joseph W. Jacob, Program Specialist, Mississippi Natural Heritage Program, January 25, 1977.

*"Biology of Subterranean Termites"* by Dr. Joe K. Mauldin, Principal Entomologist, Southern Forest Experiment Station, February 1, 1977.

*"Communicate, Communicate, Communicate"* by Miss Catherine Campbell, Public Information Officer, Gulf Coast Research Laboratory, February 22, 1977.

*"Bacteria Associated with Blue Crab Meat During Processing and Subsequent Storage"* by Ms. Sandra R. Lofton,

Microbiology Section, Gulf Coast Research Laboratory, March 1, 1977.

"*Genetic and Chromosome Defects in Clinical Medicine*" by Dr. Burwind N. Kaufmann, Chief of Outpatient and Admitting Section, Biloxi Veterans Administration Hospital, March 8, 1977.

"*Gametogenesis and Early Development of the American Oyster, Crassostrea virginica*" by Mr. Al Chestnut, Oyster Biology Section, Gulf Coast Research Laboratory, April 5, 1977.

"*Subduction Along the Western Margin of the Americas Plate*" by Mr. Allen Lowrie, Oceanographer, USN, National Space Technology Laboratory, April 12, 1977.

"*The Naval Oceanographic Program at NSTL*" by Mr. Richard H. Evans, Naval Oceanographic Center, National Space Technology Laboratory, April 19, 1977.

"*Computer Applications in the Field of Medicine*" by Dr. Danny R. Carter, Chairman, Department of Computer Science, University of Southern Mississippi, May 10, 1977.

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